LANDSLIDE MEASUREMENT SYSTEM

Ms. Archana Adhikrao Gharge [1] | Dr. Prof. Y. S. Angal [1]

[1] Dept. of ECE, JSPM's BSIOTR, Pune, Maharashtra, Pune University.

ABSTRACT

Landslide detection is very common now a days due to natural calamities. A challenging wireless sensor networks can be used to alarm the effect of landslide even before the cause occurs. The proposed work consider tiny sensor nodes for the application with base station as central manager and sensor nodes for combining the raw data that are timely coordinated to monitor all the application's. The applications considered are mountains, hills, regions with heavy rain fall where human monitoring is not possible. The sensor nodes deployed on the surface of non-reachable areas will be sending continuously measured parameters such as accelerometers voltage along X and Y axis and sensitivity accelerometers. Depending on these parameters tilt angle of a node is computed, which is compared with the threshold tilt angles. If the tilt angle is minimal than threshold value, then land sliding alarm is sent to the base stations for further action. In turn base station announces the same in the loud speaker up-to 2 km/ts. The proposed scheme result has been simulated using crossbow kit, moteview software and visual basic coding to visualize its effects in real time scenario. In this project we are going to detect temperature of that particular place and it will be displayed on screen.

KEYWORDS: WSN; Landslides; Tilt angle.

I. INTRODUCTION

Wireless sensors are attracting due to its dynamic characteristics for variety of applications. As there is fast progress in the technology in Micro-Electro-Mechanical Systems , Integrated Circuit (IC), and Radio Frequency (RF), the (WSN) Wireless Sensor Network's have been widely spread out in a variety of surveillance applications. A typical sensor network is a group of sensor nodes with a base station all connected in wireless for communication, and consists of three units a microprocessor, a sensor unit and a power control unit. Microprocessor provides intelligence support to sensor nodes which is responsible for control of sensors, execution of communication protocol and signal processing algorithms on the gathered sensor data. A sensor unit consists of large number of nodes. Individually, each node is autonomous and has less range, and they operate together and effective over a large area. Function of each node is to collect the raw information while running in a particular application and convey it to the base station. Validity of node is completely dependent on how effectively it uses power, as thousands of nodes are deployed in a network, frequent replacement of a battery is infeasible, useful power is mainly due to transmitting or receiving data, processing a query request and then forwarding the data to neighbor nodes.

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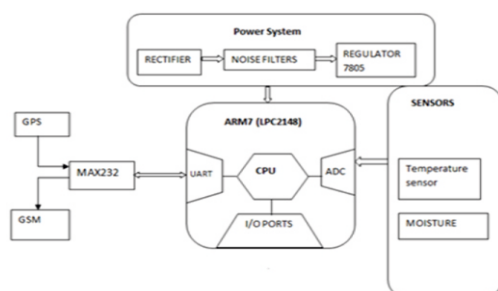
II. SYSTEM IMPLEMENTATION

Fig. 1 Block diagram of Landslide measurement system

A. Power System

This contains bridge rectifier, noise filters and voltage regulators. Rectifier will convert 230V AC voltage into 9Vand 5V DC voltage. This DC voltage will be given to main circuitry, GSM module, GPS module and peripherals of the system.

For the filtering purpose i.e. to remove noise and ripples from signal we have used filtering capacitors.

Voltage regulator 7805 is used to convert 9V supply into 5V. This converted 5V supply is given to all the peripherals to drive them. Also voltage regulator LM117 is used which will convert this 5Vsupply into 3.3V, which will be used by ARM7 microcontroller LPC2148.

B. GPS Module

GPS means Global Positioning System. This GPS module is connected to ARM7 controller through UART0 port. Any sensor detection will be received by GPS via ARM7 controller. And GPS will send this indication to GSM module through ARM7 controller.

C. GSM Module

GSM means Global system for Mobile communication. GSM is connected to ARM7 via UART1. Sensor indication transmitted from GPS module is receive by this GSM module and using SIM card inserted in module GSM will send corresponding message.

D. ARM7 – LPC2148

This is 32/16 bit microcontroller in tiny LQFP64 package. This is the heart of whole landslide measurement system, which controls all the peripheral devices attached to it. Three sensors are attached to its ADC port. ARM7 controller receives indication of sensors and it transmits and receives communication of this indication to GPS and GSM.

E. Sensors

Three types of sensors we are using in this landslide measurement project. One of them important is MEMS sensor. It is also called as accelerometer or vibration sensor. This will sense the vibration of landslide and indicate the same to ARM7 controller. Second sensor is Temperature sensor. It will detect the temperature of that particular area where this landslide circuitry is installed. And third one is humidity sensor, which will detect the humidity of that particular land. Using temperature sensor we will be detecting temperature of a landslide and it will be displayed on screen.

III. HARDWARE AND SOFTWARE DESIGN

The proposed work considers issue of land sliding in a region with disasters or heavy rain fall. To monitor such wireless sensor network areas can be considered, typical low cost sensors will fit for such applications. Monitoring can be considered as an important issue, to prevent from the harm caused to the society. The proposed scheme for land sliding detection shown in figure 3.1 is formed by considering a remote areas like hills, that are often unreachable, where setting up an Infrastructures less network by base stations are done and sensor nodes are deployed randomly on the monitoring object. Sensor nodes with certain position on object which is accurately defined with X-axis and Y-axis are on continues

monitoring of the object. The monitored data is conveyed to the base station. The newly proposed system provides the way to detect the landslide in real time using the sensor kit, thus providing a way to detect the landslide using a low cost sensors.

The demonstration of landslides can be done using crossbow kit in a real time, which consists of a base station and a set of three sensor nodes, the function of base station is to measure the parameters of objects like temperature, energy, accelerometers. These sensed parameters are sent to base station. In order to visualize these parameters in real time from base station and sensor nodes, a mote view software is considered that reads the parameters of base station and displays it on its data tab. After the simulation set up, various parameters like voltage, temperature, acceleration, light, magnitude are all displayed in mote view software. Since we are interested in calculating the tilt angle measured by the node, accelerometer readings can be used to calculate the tilt angle at each instant of time. Based on the tilt angle of node prediction of landslide can be said.

The coverage range of each sensor node using a crossbow kit is considered to be 300m, coverage can be increased by placing the nodes in series monitoring such that every node act as base station to intermediate node, collect and send the data to other neighbor node till it reaches the original base station.

As the procedure starts by synchronization of all sensor nodes with base station, considering the initial tilt angle of sensor nodes to be 90 degrees along X-Y axis, land sliding can be detected by angular change of each sensor node with respect to X and Y axis. The affecting area being monitored with sensor, considering the different conditions for angular change like when the angular change is 85 degrees just as read by the base station, we can predict that there may be chances of land sliding but it is not always the case since the change in accelerometer may be due irregularities of the considered object and the sensor is taking up's and down moment while moving. As angular change goes to 80 degrees people can be alarmed to vacant from their areas for safety reasons. When the angular change is 60 degrees there can be definite of land sliding, all the necessary preventive measures can be taken. The change in phase is detected by the accelerometer reading that is given by each node to base station. The rate change of tilt angle is detected by using the below equation.

$$\alpha = \sin^{-1} * V_{out} - V_{offset} \qquad \dots\dots\dots\dots\dots\dots\dots(1)$$

where

α : Tilt angle

Vout : Voltage output accelerometer

Voffset : Offset voltage power supply (0.4 V)

S : Sensitivity accelerometer

IV. SIMULATION AND RESULTS

using he mote view software. This software helps to know the parameters read by the sensor nodes, A visual basics coding is done in order to run the simulation model developed, which is patched with mote view software. Figure 4 shows the interfacing of crosss bow sensor nodes and base stations with the processor done in the laboratory. After the set up, sensor nodes senses the angle variation of the object, and is transmitted to base station through air interface, further in order to visualization of the data, base stations is connected to the processor with wire, the data tab of mote view display the latest sensor readings received for each node in the network. The columns includes node ID, server time-stamp and values of sensor from the sensor board firmware packet. The sensors data is automatically converted into standard engineering units. Mote view is enabled to receive the data from base station.

The experiment is carried in the laboratory, initially setting up the connection of all the devices as shown in figure 4.3, as soon as the simulation begins, sensor nodes are considered to be static, a continuous accelerometer data is sent from each sensor node to base station, moteview reads the parameters and displays it on the screen, as the nodes are made moving physically. The slide of the nodes are measured using the voltage and sensitivity parameters. The lower the tilt angle more the slide. We have set a threshold tilt angle, below which a node is declared as a slide.

V. CONCLUSION

The proposed work considers a landslide detection using a sensor nodes designed from a crossbow kit consisting of sensors and a base station which senses the real time data so as to be flexible with monitoring application. Such method can be considered as emerging technology, as with a group of low cost sensors, a large areas can be monitored for their favorable conditions. The work is carried out using an experiment done in the laboratory placing with 3 sensor nodes and a base station all connected without wire, and base station be connected to processor. As the simulation begin sensor reads accelerometer reading, a slight change in accelerometer reading may occur because of irregularities of the surface and moment of sensors. Land sliding can be detected by sudden slip of sensor nodes in certain elevations. Thus the work provides the advantage of

monitoring the remote, risky, unreachable areas where human intervention is uncommon.

VI. FUTURE SCOPE

This work can also be extended to various application like monitoring heavy rain fall in places like munar of kerala, and designing a sensor with large power to monitor the large mountains in the areas of himalayas. The range of communication can be increased like cellular network, so that monitoring and prevention can be done considering a large base station and a server, where technicians working in company can safeguard the considered object from far distance.

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